BEST AVAILABLE COPY

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
17 March 2005 (17.03.2005)

PCT

(10) International Publication Number
WO 2005/024701 A2

(51) International Patent Classification[7]: G06K 1/00

(21) International Application Number:
PCT/EP2004/051938

(22) International Filing Date: 27 August 2004 (27.08.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0321172.9 10 September 2003 (10.09.2003) GB

(71) Applicant *(for all designated States except US)*: HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P. [US/US]; Legal dept., 20555 S.H. 249, Houston, Texas 77070 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: ALBARRAN, Miguel Angel [ES/ES]; Paseo Fabra i Puig 301-303 Stico 1, E-08031 Barcelona (ES). GONZALEZ, Manuel [ES/ES]; Maspons 1, 2o 1a, E-08012 Barcelona (ES).

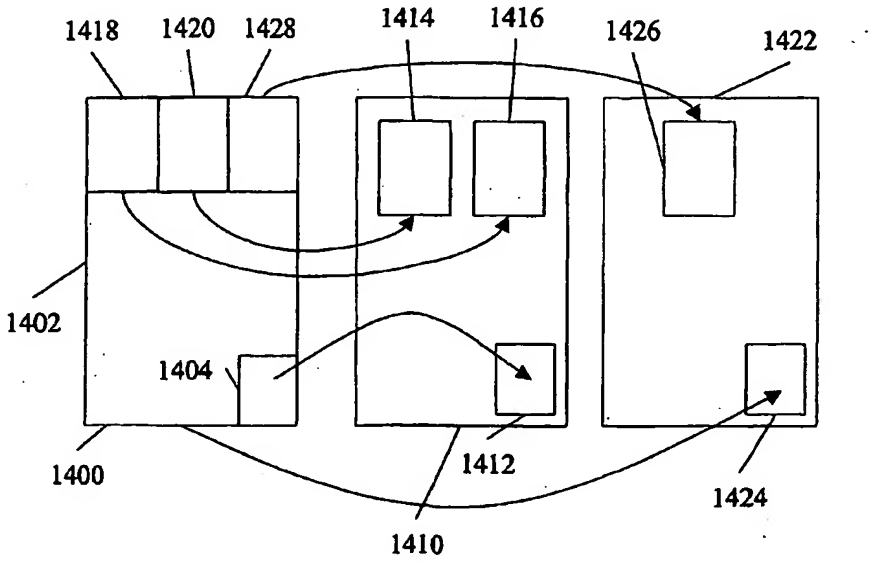
(74) Agent: LEADBETTER, Benedict; Hewlett-Packard Española, S.L., Legal Dept., Avda Graells, 501, E-08174 Sant Cugat del Valles (ES).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: CREATION OF DOCUMENTS WITH POSITION IDENTIFICATION PATTERN



(57) Abstract: A system for creating documents (100, 1410) having a position identifying pattern (108) thereon, the system comprising a pattern allocation system arranged to receive a request for a plurality of pattern space areas for respective pattern areas of a document, to analyse an area of available pattern space thereby to identify a suitable pattern space area for allocation to each of the pattern areas, and hence to determine the relative positions of the pattern space areas in pattern space.

WO 2005/024701 A2

Published:

— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

CREATION OF DOCUMENTS WITH POSITION IDENTIFICATION PATTERN

FIELD OF THE INVENTION

The present invention relates to the creation of documents which have a position identification pattern, made up of markings on the document, which can be detected by a suitable detection system and used to distinguish different positions on the document. The printed document may be a form or other printable document such as a label or note pad.

BACKGROUND TO THE INVENTION

It is known to use documents having such position identification markings in combination with a pen having an imaging system, such as an infra red camera, within it, which is arranged to image a small area of the page close to the pen nib. The pen includes a processor having image processing capabilities and a memory and is triggered by a force sensor in the nib to record images from the camera as the pen is moved across the document. From these images the pen can determine the position of any marks made on the document by the pen. The pen markings can be stored directly as graphic images, which can then be stored and displayed in combination with other markings on the document. In some applications the simple recognition that a mark has been made by the pen on a predefined area of the document can be recorded, and this information used in any suitable way. This allows, for example, forms with check boxes on to be provided and the marking of the check boxes with the pen detected. In further applications the pen markings are analysed using character recognition tools and stored digitally as text. Systems using this technology are available from Anoto AB and described on their website www.Anoto.com. The pattern space in known systems is generally divided up into blocks for ease of allocation. For example the Anoto system divides the space into

sections, each section into shelves, each shelf into books and each book into pages, a page representing the smallest unit of pattern space which can be allocated to a particular document.

For such a system to be able to handle a large number of documents it is desirable for the system to be able to define a large area of pattern space, any part of which can be identified by the markings on it, and to be able to allocate parts of that pattern space to respective documents in such a way that the allocation can be recorded and referred to when the document is used. In known systems this is typically achieved by defining a number of pages within the pattern space, allocating a group of pages to a particular application, such as a particular type of form, and printing a group of documents each one having a page of the pattern space on it. The documents are then stored or distributed as hard copy for later use.

It is known from WO 01/75723 to provide a system for producing valuable documents such as gift vouchers. In this system a central server has defined in it a number of coordinate areas, i.e. predefined areas of pattern space, together with an ordering system for a valuable document having a predefined format. A user who wants to order a gift voucher connects his computer to the server and inputs information specific to his request such as the name and address of the intended recipient of the document. The server then allocates an area of pattern space to the document before forwarding the document to the recipient, who prints it out for use. Alternatively the document can be printed out by the server and sent to the recipient by post.

SUMMARY OF THE INVENTION

The present invention provides a system for creating documents having a position identifying pattern thereon, the system comprising a pattern

allocation system arranged to receive a request for a plurality of pattern space areas for respective pattern areas of a document, to analyse an area of available pattern space thereby to identify a suitable pattern space area for allocation to each of the pattern areas, and hence to determine the relative positions of the pattern space areas in pattern space.

The present invention also provides a pen stroke interpretation system arranged to interpret pen strokes made on a pattern area of a document having a position identifying pattern thereon, the system having defined therein a plurality of pattern space areas taken from a defined pattern space and allocated to a particular document, and, for each of the pattern space areas, an individual association with the particular document and a particular function associated with that document, whereby the pen stroke interpretation system can identify each of the pattern space areas and process pen stroke data associated with it.

The present invention further provides method of allocating pattern space to a document, the document having a plurality of pattern areas with a position identifying pattern thereon, the method including defining a pattern space, receiving a request for a plurality of pattern space areas within the pattern space for respective areas of a document, analysing an available area of the pattern space thereby to identify a suitable pattern space area for allocation to each of the pattern areas, and hence to determine the relative positions of the pattern space areas in pattern space.

The present invention still further provides a system for creating documents having a position identifying pattern thereon, the system comprising, a pattern allocation means arranged to allocate pattern from a pattern space, the pattern space being divided into a plurality of pages, wherein the pattern allocation means is arranged to allocate a pattern space area

comprising a first part of one of the pages to the document, and keep a further pattern space area comprising a second part of that page available for allocation to another document.

Such a system has the advantage that a whole page of pattern space does not need to be used up for each document that is created. In particular, if the documents have only small pattern areas on them, then two or possibly many more, documents can be created, each having unique pattern space allocated to it, but without using up a whole page of pattern space for each document. In a system where each page of pattern space is charged for, this can reduce the cost of creating the documents. It also means that, for any finite area of defined pattern space, a greater number of documents can be created before the pattern space is all used up.

The present invention further provides a system for creating documents having a position identifying pattern thereon, the system comprising pattern allocation means arranged to allocate pattern space areas from a pattern space to respective pattern areas on a document, such that the relative positions of the pattern areas on the document differ from the relative positions of the respective pattern space areas in the pattern space.

Such as system provides desirable flexibility in the allocation of pattern space to a number of documents. For example for a document having a plurality of separate pattern areas distributed over it, a total area of pattern space smaller than the total area of the document can be allocated to the document, that area being divided up into a number of parts each of which is allocated to a respective one of the document pattern areas. Again, this helps to keep down the amount of pattern space that is used up for each document.

Preferably the pattern allocation means is arranged allocate one of the pattern space areas to a pattern area of the document and to select said one of the pattern space areas on the basis of the size of the pattern area, and the layout of available parts of the pattern space that have not already been allocated. This allows the pattern space allocation means to allocate pattern space in an efficient manner selecting the most suitable pattern space areas for any particular document, and allows the allocation to take place at the time the document is created. It is useful where the pattern space areas are of different sizes, and allows a particular portion of the pattern space to be easily allocated to a number of documents having different designs, or being associated with different applications.

Preferably the pattern space allocation means is arranged to make a record of the allocation of the, or each, pattern space area to enable the interpretation of pen strokes made on the document. Each pattern space area may be identified in the record by means of its absolute position in the pattern space, optionally as well as its size and orientation. Such a record, when communicated to a pen stroke interpretation system, can enable it to interpret pen strokes without reference to any other pattern space allocation system, such as the allocation of the whole of a particular region, or page, of the pattern space to the document.

Where the system is arranged to create documents from which pen strokes can be interpreted by a plurality of pen stroke interpretation systems, the record may include an indication of an appropriate pen stroke interpretation system for the documents. Again this can increase the flexibility of the system because it allows the allocation of pattern space to documents associated with a number of different applications substantially at the time of creation of the documents.

Where each page has a pre-defined document completion pattern space area arranged to be used to indicate when a user has finished marking a document, the pattern allocation means may be arranged to allocate the document completion pattern space area from one page to more than one document. Provided a suitable record of each of the pattern space area allocations has been made, including an indication of the identity of the document to which each pattern space area has been allocated, the pen stroke data analysis can determine which document any pen strokes have been made on without the document completion pattern space being unique to a particular document.

The present invention further provides a pen stroke interpretation system arranged to interpret pen strokes made on a pattern area of a document having a position identifying pattern thereon, the system having defined therein a plurality of pattern space areas taken from a defined pattern space and allocated to a particular document, and, for each of the pattern space areas, an association with the particular document and a particular function associated with that document, whereby the pen stroke interpretation system can identify each of the pattern space areas and process pen stroke data associated with it.

The present invention also provides a data carrier carrying data arranged to cause a computer system to carry out the method of the invention or to operate as a system according to the invention. The data carrier can comprise a floppy disk, a CDROM, a DVD ROM/RAM (including +RW, -RW), a hard drive, a non-volatile memory, any form of magneto optical disk, a wire, a transmitted signal (which may comprise an internet download, an ftp transfer, or the like), or any other form of computer readable medium.

Preferred embodiments of the present invention will now be described by way of example only with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a document printed according to the invention;

Figure 2 shows in detail part of the document of Figure 1;

Figure 3 shows a computer system arranged to process information from the form of Figure 1;

Figure 4 shows a pen for use with the document of Figure 1;

Figure 5 shows a system according to an embodiment of the invention for creating and printing the document of Figure 1;

Figure 6 is a flow diagram showing a method of designing a form using the system of Figure 5

Figure 7 shows the allocation of pattern space to the document of Figure 1;

Figure 8 shows an electronic file defining the document of Figure 1;

Figure 9 is a flow diagram showing the process according to an embodiment of the invention of printing the document of Figure 1 on the system of Figure 5;

Figure 10 shows a modification to part of the form of Figure 1;

Figure 11 is a flow diagram showing a method, according to an embodiment of the invention, of modifying the document of Figure 1 before printing;

Figure 12 shows a method according to a further embodiment of the invention for allocating pattern space to documents similar to those of Figure 1;

Figure 13 shows a document design for use in the system of Figure 5, and

Figure 14 shows the allocation of a page of pattern space to two documents by the system of Figure 5.

Referring to Figure 1 a document 100 for use in a digital pen and paper system comprises a carrier 102 in the form of a single sheet of paper 104 with position identifying markings 106 printed on some parts of it to form areas 107 of a position identifying pattern 108. Also printed on the paper 104 are further markings 109 which are clearly visible to a human user of the form, and which make up the content of the document 100. The content 109 will obviously depend entirely on the intended use of the document. In this case an example of a very simple two page questionnaire is shown, and the content includes a number of boxes 110, 112 which can be pre-printed with user specific information such as the user's name 114 and a document identification number 116. The content further comprises a number of check boxes 118 any one of which is to be marked by the user, and two larger boxes 120, 121 in which the user can write comments. The form content also includes a send box 122 to be checked by the user when he has completed the questionnaire to initiate a document completion process by which pen stroke data is forwarded for processing, and typographical information on the form such as the headings or labels 124 for the various

boxes 110, 112, 118, 120. The position identifying pattern 108 is only printed onto the parts of the form which the user is expected to write on or mark, that is within the check boxes 118, the comments boxes 120, 121 and the send box 122.

Referring to Figure 2, the position identifying pattern 108 is made up of a number of dots 130 arranged on an imaginary grid 132. The grid 132 can be considered as being made up of horizontal and vertical lines 134, 136 defining a number of intersections 140 where they cross. The intersections 140 are of the order of 0.3mm apart, and the dots are of the order of 100? m across. One dot 130 is provided at each intersection 140, but offset slightly in one of four possible directions up, down, left or right, from the actual intersection 140. The dot offsets are arranged to vary in a systematic way so that any group of a sufficient number of dots 130, for example any group of 36 dots arranged in a six by six square, will be unique within a very large area of the pattern. This large area is defined as a total imaginary pattern space, and only a small part of the pattern space is taken up by the pattern on the document 100. By allocating a known area of the pattern space to the document 100, for example by means of a co-ordinate reference, the document and any position on the patterned parts of it can be identified from the pattern printed on it. An example of this type of pattern is described in WO 01/26033. It will be appreciated that other position identifying patterns can equally be used. Some examples of other suitable patterns are described in WO 00/73983 and WO 01/71643.

Referring to Figure 3 an internet based system for using the document 100 comprises a pen 300 arranged to write on the document 100 and to detect its position on the document from the pattern 108, and an internet connected personal computer (PC) 302 arranged to run an application for processing data from the pen 300, for example by modifying a file in which

the document 100 is stored electronically in response to pen strokes made on the document 100 with the pen 300. The PC 302 includes a user interface including a screen 314, a keyboard 316 and a mouse 318, as well as a processor, a memory, and I/O software devices by means of which the processor communicates with the screen 314, the keyboard 316, the mouse 318 and a communications port by means of which it communicates with the internet. The system also includes an internet connected server 304 which has stored on it a record of which areas of the pattern space are allocated to which documents, and which is also able to allocate unused areas of the pattern space to documents on request. An application service handler (ASH) 306, which is a program run, in this case, on a separate server having its own memory, processor I/O devices and communications port, is also provided with internet connection. The ASH 306 is arranged to interpret the pen strokes recorded by the pen 300, as described below, converting them to an input suitable for the application on the PC 302. The ASH includes an intelligent character recognition (ICR) program so that it can interpret handwritten input on the document 100 and convert it to digital text. A further ASH 307 is also provided, and is associated with a different application and arranged to interpret pen strokes for that application. Essentially there is one ASH for each application that makes use of the digital pen and paper system. Each ASH 306, 307 needs to have a record of the layout of any particular document 100 including the positions, dimensions and functions of each of the patterned areas so that it can process any pen strokes made on the document 100. A printer 308 is also provided, which in this case is on a local network 310 with the PC. The printer 308 in this case is a laser printer with 1200 dpi resolution. Other printers having sufficient resolution to print the position identifying pattern could also be used. A local paper lookup service (LPLS) 309 is also provided on a separate server with internet connection. This includes a program arranged to receive data from the pen when the pen has been used

on the document 100, the data identifying which areas of pattern space have been written on. Typically the pattern space that is associated with the send box 122, and which the pen 300 has recognized as a prompt to contact the LPLS, is identified to the LPLS 309. The LPLS 309 is then arranged to interrogate the pattern allocation server 304 to determine the unique identity of the document 100, and which application the document is associated with, and therefore which of the ASHs 306, 307 should be used for that application. The LPLS then identifies the appropriate ASH 306 and the document identity to the pen. The pen can then send the pen stroke data and the document identity to the correct ASH 306, 307.

It will be understood that the various components of the system can all be located at separate locations, communicating via the internet as described. Alternatively some or all of them could be provided together on a single server, or grouped on a local network. This might be appropriate where a self-contained system for a limited number of applications is required.

Referring to Figure 4, the pen 300 comprises a writing nib 510, and a camera 512 made up of an infra red (IR) LED 514 and an IR sensor 516. The camera 512 is arranged to image a circular area adjacent to the tip 511 of the pen nib 510. A processor 518 processes images from the camera 512 taken at a predetermined rapid sample rate. A pressure sensor 520 detects when the nib 510 is in contact with the document 100 and triggers operation of the camera 512. Whenever the pen is being used on a patterned area of the document 100, the processor 518 can therefore determine from the pattern 108 the position of the nib of the pen whenever it is in contact with the document 100. From this it can determine the position and shape of any marks made on the patterned areas of the document 100. This information is stored in a memory 520 in the pen as it is being used. When the user has finished marking the document, in this case when the

questionnaire is completed, this is recorded in a document completion process, for example by making a mark with the pen in the send box 122. The pen is arranged to recognise the pattern in the send box 122 and determine from that pattern the identity of the document 100. It then sends this document identification information to the LPLS 309, which identifies the relevant ASH 306 to the pen 300, by sending the URL of the ASH 306 to the pen 300. The pen stroke data is then sent by the pen 300 to the ASH 306 which converts it to a suitable format for input to the application 402. The pen 300 can be connected to the network in any suitable manner, but in this case it is via a Bluetooth radio link with the PC 302. Suitable pens are available from Logitech under the trade mark Logitech Io.

In order to provide flexibility the system also needs to be set up so that the user can generate whatever number of documents 100 he needs for a particular application. Referring to Figure 5, which shows the functional units of the system, printing of documents 100 is controlled by a print on demand (PoD) tool 400, which is arranged to receive print demands from the application 402, and to send print instructions to a print engine 404 in the printer 308 via a printer driver 406 on the PC 302. The PoD tool 400 is also arranged to communicate with the a pattern allocation module 408 in the pattern allocation server 304 to send a request for allocation of a required area of pattern space, and receive back an indication of the allocated space. In this case the PoD tool 400 takes the form of software in a printer filter driver within the PC 302. However, it could incorporated in firmware in the printer 308.

The application 402 is arranged to create, design, modify, and process documents such as the questionnaire document 100 shown in Figure 1. It therefore has access to a number of document definition files and templates, which are stored as PDF (Portable Document Format as defined

by Adobe) files in the memory 403 of the PC 302. One of the templates 410 forms the basis for the document 100. The templates each correspond to a separate document name and include information relating to a respective type of document. This includes the number of separate pattern areas required from the pattern allocation server 304 for the document type, and the dimensions of those areas. It should be noted that these areas as defined by the pattern allocation server 304 do not necessarily correspond to the areas on the document 100. This is because the system can take any pattern area allocated by the server 304, and split it up and move parts of it around on the document 100 as will be described in more detail below. However this information needs to be sufficient to get a large enough total pattern area from the server 304, and provide a sufficient indication as to its use for the server 304 to be able to allocate it. In this case the server 304 allocates the pattern areas in pages, and for the form 100 only one page of pattern is required. Therefore the document template simply specifies the need for one page of pattern space and indicates the use only in general terms by means of the document ID. The saved document files generally include the information from one of the templates and further information designed into the specific document. The full makeup of the document definition files is described in more detail below.

The PC's user interface 412 allows a user to view documents using the application 402 on the screen 314 of the PC 302, and make modifications to them. The user interface 412 includes the keyboard 316 and mouse 318 and software for processing inputs from them, as well as the screen 314 and software for producing the images on it. The application 402 has access to a database 414 of data, such as user names 114 and identification numbers 116, which will need to be associated with each particular document 100 and printed out with the document 100 as pre-filled data. This database 414 may be on the PC or elsewhere on the network.

In order to produce a set of digital documents 100, the first step is the design and creation of the document. Referring to Figure 6 this starts at step 600 with the design of the content of the document, which is carried out on the PC using the application 402 or some other application. In this case the application is Acrobat Reader and the PC 302 also runs a number of other applications including a word processing package such as 'Word' a database package such as 'Access', and a spreadsheet package such as 'Excel'. Each of these can be used to design the content of the document. Then the areas of the document to which the pattern 108 are to be applied are defined by the user. In this case this is carried out using a form design tool (FDT) 416 in the form of an Acrobat 5.0 plug-in. The content is therefore converted to PDF format at step 602, and the pattern areas defined using the FDT 416 at step 604, producing a digital document defining both the content and the positions and shapes of the pattern areas.

Depending on the FDT 416, those areas 107 can be defined in terms of their absolute positions, sizes and shapes on the document, or in relation to the content, such as by an indication of which of the boxes 114, 116, 118, 120, 121, 122 are to have the pattern 108 printed in them. Association of a pattern area 107 with a content feature, such as a check box, can be used such that moving the content feature within the document design moves the associated pattern area 107 with it. This is helpful when designing and modifying the document. In either case, although there is a specific pattern area 107 associated with each of the printed boxes 118, 120, 121, 122, the pattern areas 107 do not have to correspond exactly to the areas of the printed boxes 118, 120, 121, 122. The pattern areas 107 will each generally be made larger than the box 118, 120, 121, 122 with which it is associated, so that when a user is writing or making some other mark within one of the

boxes, if he is slightly inaccurate in positioning the mark on the page, the pen 300 will still be able to detect where it is on the page.

The pattern areas 107 can also have allocated to them a nominal relative position within the total pattern space area that will be requested from, and allocated by, the server 304. Referring to Figure 7, the single page 700 of pattern space required for the form 100 can be broken down by the FDT 416 into a number of separate pattern space areas 718, 720, 721, 722 which are to be allocated to the respective boxes 118, 120, 121, 122 on the form 100. These pattern space areas 718, 720, 721, 722 can be arranged on the page 700 of pattern space in any suitable way, and in particular the relative positions of the pattern space areas 718, 720, 721, 722 on the pattern space page 700 can differ from their relative positions on the final form 100. Because the form 100 only has some specific areas covered by the pattern 107, and other areas to which no pattern is applied, this allows the amount of pattern space used to be kept to a minimum. In this example it allows a two page form 100 to be produced using only a single page 700 of pattern space. Each area is identified by its coordinates on the page 700. In this case it is assumed that all allocated pattern space areas will be rectangular, and each is identified by the position of its top left and bottom right corners. The coordinate system used has its origin at the top left hand corner 724 of the page and includes an x coordinate indicating the distance to the right of the origin, and a y coordinate indicating the distance down from the origin. The pattern space area 720, for example, is identified by the coordinates $(0,0; x_1\ y_1)$.

The nominal allocation of the pattern space areas 718, 720, 721, 722 is carried out by the FDT 416 once the form layout has been determined by the user. This allows the division of the allocated pattern space 700 to be performed in the most efficient manner with the minimum amount of

wasted pattern space. It is possible for the user to specify an alternative division of the allocated pattern space 700.

Then the functions associated with the various patterned areas 718, 720, 721, 722 are defined at step 608 so that the application 402 can process data received back when the document 100 has been written on. In the case of the questionnaire document 100 the pattern areas in the larger boxes 120, 121 are identified as a graphical input areas, for which any pen markings should be stored graphically, or perhaps analysed using character recognition and stored as text. The pattern associated with the check boxes 118 is associated with the respective response options so that the checking of the boxes 118 on a number of the forms 100 produces a standard mark, such as a cross, in the check box of the stored document. The pattern associated with the send box 122 is associated with the send function which will cause the pen to stop recording pen strokes for the document 100 and send them to the ASH 306.

Finally the designed document is saved and allocated a document name at step 610.

When the form 100 has been completely designed, all of the information relating to the form is stored as a PDF file 800 as shown in Figure 8. This PDF file contains graphical information 802 defining the content of the form 100, and a pattern area definition 804 defining the sizes and positions of the pattern areas on the document 100, and their associated functions, and also their nominal relative positions in the pattern space page 700 which will be allocated to the document 100. It also contains a document ID 806, an identification 808 of the pattern associated with the send box 122, a traceability code 808, and other active information 810. The PDF file also contains mapping information 812 for mapping data from

databases or other sources onto the document 100. In this case this would be the location of the user's name 114 and ID 116 on the database 414, as well as values 814 for pre-filled fields, in this case being the user's name 114 and ID 116 as extracted from the database 414. It also contains a document instance ID 816 which is unique to the individual document to be printed. This may not be inserted until the time of printing. Normally there will only be one printed document with a particular instance ID 816 so that documents can be tracked and identified. However, in some cases it may be desirable to be able to print more than one copy of exactly the same document with the same instance ID.

The method of defining the pattern areas 718, 720, 721, 722 in the document definition, in this case the PDF file, needs to be such that when the document is sent, in this case by Acrobat Reader, to the PoD tool 400 for printing, the information defining the pattern areas is in such a format that it will be sent to the PoD tool, but does not take the form of a real graphic object that will be printed. This can be achieved in many ways, but in this example it is by embedding the data defining the pattern areas 718, 720, 721, 722 as an invisible font in the PDF file. Text characters are defined in a predetermined manner by a string of data, and part of the string for each character defines the font in which the character will be printed. The data defining the pattern areas 718, 720, 721, 722 is therefore put into the format of a series of text characters, with a non-valid font definition so that they will not be printed as characters by the printer. The PoD tool 400 is arranged to recognize these non-printable text characters, by means of the font definition they include, and interpret the data defining them in a different manner as identifying the size, shape, and position of the required pattern areas 718, 720, 721, 722. It then responds by requesting the required areas from the pattern allocation module 408.

The definition of the pattern areas 718, 720, 721, 722 can be further identified by means of tags at the ends of the data string defining them. These tags alert the PoD tool 400 to the fact that the data between them is to be interpreted as a definition of the pattern areas 718, 720, 721, 722.

When the PDF file is sent for printing each of the graphic objects that it contains will be received by the PoD tool 400. The valid graphic objects will be converted to a suitable format and sent for printing. The non-valid objects will be converted to a request to the pattern allocation module 418 which will respond by sending a definition of the required pattern areas to the PoD tool, which in turn will convert them to a suitable format for printing and forward them to the printer.

Once the document 100 has been designed, the user indicates, using the FDT 416 that it is completed, and the FDT 416 saves the document as a PDF file and allocates a document name to the document 100 as indicated above. The FDT 416 also creates a Paper Application Definition (PAD) file which is a file defining those features or parameters of the document 100 that will be needed by the ASH 306 to interpret pen strokes made on the document 100. Those parameters include the size and shape of the pattern areas, their nominal relative positions in pattern space, in this case their positions on the page 700 of pattern space, and their functions, such as whether they are check boxes, areas for graphical input, areas for ICR analysis or areas having other functions. These parameters are the ones necessary to allow the processing of pen strokes made on the document 100 using the pen 300. The exact positions of the pattern areas on the document 100 are not included in these parameters, as the layout of the document 100 can be varied as will be described below. The PAD file is transmitted to the ASH 306 when the document 100 has been designed, so that the ASH can

interpret pen strokes on the document 100 and produce the necessary inputs to the application 402.

The pattern space area 722 allocated to the send box 122 also needs to be identified to the pen 300 so that it can detect when it is written on and respond by sending the pen stroke data. This information can be transmitted to the pen 300 using the Bluetooth link when the document 100 has been designed. However it is more convenient for the template 410 for the document 100 to define an area, within the required page 700 of pattern space, which will always be associated with the send box 122. A number of pages of pattern space are then generally allocated to documents using that template. The pen can therefore have a record of all the possible pattern space areas 722 that can be allocated to send boxes 122 of forms 100 from the template 410. It will then recognized any of those areas when it writes in one of the send boxes 122, and respond by sending the pen stroke information to the LPLS 309. A still further possibility is to use the same area of pattern space for the send box 122 on all forms 100 produced from the template 410. In this case the send box will not have an individual document ID associated with it, but once the ASH 306 receives the pen stroke data it can determine from that data which page of pattern space has been used, and therefore the individual document ID.

Referring to Figure 9, once the document has been designed, the user can print it out locally using the printer 308. Typically a number of versions of the document 100 will be required, for example a number of questionnaires each with different instance IDs for use by different respondents. However the simplest case is the printing of a single document which will now be described. In this case it is assumed that the user wants to print off one copy of the document 100 for a single respondent, with the name and ID number of the respondent being taken from the database 414.

First the user therefore selects the document design by its document name, at step 900 using the user interface 412, and opens the document at step 902 so that he can view it using the application 402. He can then insert manually any pre-filled data to be included in the document. Then at step 904 to start the printing process he selects a printing option, which causes the PoD tool 400 to open a printing user interface (UI) at step 906. Using the printing UI he requests the number of prints and various other printing parameters. The PoD tool 400 identifies from the document file name that the document is one having the position identifying pattern on it and identifies the printers on the network which are capable of printing the pattern to a satisfactory quality. These might include high resolution (1200 dpi) inkjet and laser jet printers. Other printers on the network which are not suitable for printing the pattern are not identified to the user. The list of suitable printers is displayed to the user, who can then select one of them for the print job at step 908. The user then also indicates the number of prints he wants to print, in this case one. Then the user initiates the actual printing, inputting a print command via the printing UI.

When the actual print is initiated, the PoD tool 400 allocates a unique instance ID to the printed document 100 at step 910. It then requests the required amount of pattern space from the server 304, in this case one page, providing the document name and instance ID to the server 304. Provided a suitable area of pattern space is available it receives back a definition of the required pattern space as a single area. This can be, for example, as a co-ordinate reference within the total pattern space, or as a full definition of the actual pattern to be used, such as a bit map. The PoD tool 400 then divides up the pattern space in the required manner to fit the pattern areas on the document, at step 912, as shown in Figure 7, and adds this information to the PDF file 600. The PDF file 600 then contains all the

information required to print the document 100 for the first respondent. It therefore converts the PDF file into a language that can be understood by the base printer driver 406, such as PCL5 or Postscript, and sends it to the base printer driver 406, from where it is sent to the print engine 404 which controls the printing of the hard copy document 100. If a suitable single area of pattern space is not available for allocation, or if allocated would result in an inefficient use of pattern space, then the pattern allocation server 304 may need to allocate the pattern areas for the document separately, so that their nominal relative positions in pattern space are not used. The manner in which this can be achieved is described below.

If the user wants to print a number of documents 100 for different recipients he first opens the document 100 using the application 402, and then uses the FDT 416 to modify the document to produce a number of individual PDF files corresponding to the individual documents, each one including a mapping to a respective respondent name and ID number from the database 414. These are then sent to print as a batch, and for each one the allocation of a unique instance ID and the printing process proceeds as described above with reference to Figure 9.

For any application it is likely that a number of completely different document designs will be needed, and these will be designed separately and have different document names. These could range from a simple blank page with a single un-broken page of position identifying pattern printed on it, to simple single page documents with a single small area of position identifying pattern, to complex multiple page documents with a large number of separately defined pattern areas. For each document type the ASH 306 needs to have been provided with a definition of all of the pattern areas including their sizes, relative nominal positions in the pattern space, and the type of processing required for the pen strokes made on them.

However, for any particular document design, such as the questionnaire form 100, the user may wish to modify the design of the document before printing it. Using the system described above, the document 100 can be modified in various ways, and the way in which it is modified will determine how the modifications need to be recorded in the system.

The simplest modifications are those that do not alter the overall layout of the document. For example the colour of the content and the font of any written content can be modified before the document is printed without affecting the operation of the system at all. These features can conveniently be changed using the printing UI at the time of printing. Other modifications to the content can also be made easily, such as amending the written content to make it more suitable for a particular use.

Moving the pattern areas 107 around on the document also does not affect the processing of the document, as the processing relies on the recognition of a pattern area by the pen 300 and the processing of pen markings made on that pattern area by the ASH 306. As each of the pattern areas 107 on the document 100 is separately defined in the total pattern space and identified with a function, the actual position of the pattern areas on the physical document 100 does not affect the operation of the system. Therefore, for a document that has been designed and given a document name, such as the document 100, the mobility of the pattern areas 107 allows modifications to the positions of the pattern areas 107 to be made before the document is printed without affecting processing of the document. For example, the check boxes 118 and their associated pattern 108 can be moved, or have their positions swapped with the comments box 120. This mobility in the pattern areas 107 obviously gives significant freedom in the design and modification of the document 100. Where the content of the document varies significantly between the different

instances, for example where the content includes written information which can vary significantly in length, the document can be made self formatting to a certain extent so that the position of the content and associated pattern areas 107 is adjusted automatically to provide suitable formatting for the document 100.

Some modification to the size and function of each of the pattern areas 107 can also be made for a particular instance of the document 100. However these modifications will need to be communicated via a PAD file to the ASH 306 so that it can properly interpret the pen strokes made on the document 100. For example, as shown in Figure 10, the comments box 120 could be divided into two separate areas 120a, 120b, which would be spaced apart on the printed document 100 and have different headings printed next to them to indicated to the recipient that they are for different purposes. For example, they could be headed 'positive comments' and 'negative comments'. Also the total area of the two boxes could be made smaller than that of the original box 120, so that some of the pattern area 120 allocated to the comments box would in effect not be used or needed. The unused pattern area 120c can either not be printed at all, or it can be printed, and pen strokes made on it ignored by the ASH. If not printed at all it can be reserved for allocation to other documents.

The comments written in the two areas would then need to be distinguished by the ASH 306 when the pen strokes are analysed, and stored in different fields in the electronically stored document. In order to make such an amendment a process as shown in Figure 11 is used. The document is opened at step 1102, then it is amended at step 1104 using the FDT 416. The pattern areas and their functions are re-defined at step 1106. The amended form is then saved again at step 1108 and given a different document name, and the details of the new design are saved in a new PAD

file which is forwarded to the PAD file store 409 at step 1110. With this type of modification of the document 100 it is not necessary to notify the pattern allocation module 408, since it can still allocate the same amount of required pattern space, in this case the single page 700, to the document. In a similar manner, the two separate comment pattern areas 120, 121 could be merged into a single pattern area, so that comments written on any part of the merged area would be saved together. In this case the pattern allocation would most conveniently be made to allocate the merged pattern area as a single block. However, as an alternative the new PAD file could define two separately allocated areas to be treated by the ASH 306 as a single area.

In the system as described so far, the pattern allocation module 408 only needs to keep a record of the particular printed document to which a particular pattern area page has been allocated. The more detailed allocation of specific areas within the page does not need to be made by, or even communicated to the allocation unit. Such an arrangement may be useful where a supplier of pattern sells pages of pattern space to the user. However, in some cases the user company may have purchased, or generated for itself, a large area of pattern space to use and re-use according to its needs. In this case the pattern allocation module 408 can manage the pattern allocation at a more detailed level and in a more flexible manner. The nominal relative positions of the pattern space areas can be modified by the allocation module 408 if appropriate. This enables the system to overcome the problem mentioned above where allocation of a single area of pattern, to be split up and used for the different pattern areas of the document, either is not possible, or does not lead to an efficient use of pattern space. Indeed, the nominal positions of the pattern space areas may not even be defined by the FDT 416 at all. The pattern allocation module 408 can also perform the functions of the LPLS 309 described above, receiving the pen stroke data from the pen 300 and identifying back

to the pen 300 the identity of a document and the appropriate ASH 306 from the send box pattern. In this case the pattern allocation module 408 keeps a record of each separate allocated pattern space area, including its size and shape and position in the pattern space, the unique identity of the document to which it has been allocated, the function of the pattern space area to which it has been allocated, the application with which the document is associated and the appropriate ASH 306. Much of this data is defined in the PAD files, and in this type of system the server on which the pattern allocation module 408 is held can also have the PAD files of all of the designed documents stored on it. In this case the pen stroke data from the pen is sent to this server which performs the function of the LPLS 309, as described above, and can identify the document and its associated application from that penstroke data. The server then sends the pen stroke data with the relevant PAD file to the relevant ASH to enable it to process the pen stroke data. Also in this case the FDT 416 does not need to specify even nominal relative positions in pattern space of the various pattern space areas to be allocated to the pattern areas 107 on the document 100. Each area of pattern space can be allocated separately by the allocation module 408, as is described in more detail below.

Referring to Figure 12, the pattern space page 700 from Figure 7 has the pattern areas 718, 720, 721, 722 defined upon it as described above with reference to Figure 7. Those areas have been arranged so as to minimize the amount of unused pattern space on the page 700. However they still form an irregular shape on the page 700 and, if one page is used per printed document, then there will be areas of the pattern space which are never used. In order to reduce the amount of unused space, the pattern allocation module 408 can be arranged to allocate any available pattern space to any document instance using an algorithm that is arranged to reduce the total unused pattern space. In this case, when a document is to be printed, the

PoD tool 404 requests from the server 304 not just a single pattern space page, but the exact pattern areas it needs, defining their size, shape and relative orientation, as well as the document instance ID. The server 304 then takes these areas from the available pattern space in the most efficient manner. In this example, the only restriction on the use of pattern space is that an area 701 at the bottom of the page 700 is reserved for allocation to send boxes. This area 701 is therefore identified to any pens to be used with the system, so that they can identify when a send box has been marked. The pattern area 722 for the form 722 can therefore be considered to have been taken from the area 701 because of the specific designation of that area.

If a further questionnaire similar to the first one 100 is to be printed, this will require pattern areas 718a, 720a, 721a and 722a corresponding to the pattern areas 718, 720, 721, and 722. In this case some of these can be taken from the same pattern space page 700, as shown in Figure 12, and some of them from an adjacent page of pattern space 700a. It should be noted that the relative position on the page 700 of the pattern areas 718a, 720a, 721a and 722a for the second document instance can be different from those of the first document instance, each separate pattern area being taken from the most appropriate place. Also, all of the pattern areas for any one document instance to not need to be adjacent to each other, and can in theory be taken from any point in the available pattern space. The pattern space 722a allocated to the send box of the second document must, however, be taken from the designated area 701.

It will be appreciated that the relevance of the pattern space being divided into pages is less relevant in this arrangement. Although it may still be so divided for ease of identification of any area in the pattern space, the server 304 can treat all of the pattern space at its disposal as a single continuous

area. Each pattern area to be allocated can be taken from any point on any page. As shown for the area 721a, a single pattern area can extend over the nominal division between two pages 700, 700a.

When each of the forms 100 have been completely defined and are ready for printing, a PDF file and a PAD file are created for each of them. In this case the PAD file identifies completely the specific area of pattern space allocated to each pattern area on the document. It does this by identifying the page 700, 700a and the coordinates on the page of each pattern space area. The PAD file is then sent to the server 304 for storing and forwarding to the ASH 306.

Referring to Figure 13, a further example of a document design 1300 is arranged for general use. This document design, stored as a PDF file, specifies very few details of the pattern areas on the document and no details of the document content. Specifically the document design defines a large pattern area 1302, the use of which is not specified, and a small pattern area 1304 which is designated as the send box. Because nearly the whole of the document design 1300 is to have pattern applied to it, the required pattern space to be allocated to the document is a single page of pattern space. When this document design 1300 is used in the system of Figure 5, the user has a large degree of freedom as to how the pattern area 1304 is to be split up, and what content he wants to add to the document. Using the PoD tool 400 the user can define a number of areas 1306, 1308 within the pattern area 1304 and assign functions to them, and could, for example, produce a final design similar to that of Figure 1. However, in this case, at the pattern space allocation step, the allocation of areas of pattern space is not carried out separately for each of the various pattern areas 1304, 1306, 1308 in the document, but rather a single page of pattern space is allocated to the document instance to be printed. The exact pattern

space area that will be allocated to each of the pattern areas 1304, 1306, 1308 therefore depends on its position on the document 1300, and that information needs to be included in the PAD file sent to the server 304, for subsequent forwarding to the ASH 306 when the document is printed. In this case as the send box area 1304 is specified, it does not need to be identified to the pen 300 for each printed document instance, provided the pen 300 has a record of a group of pattern space pages to be allocated to document instances produced from the design 1300.

Referring to Figure 14, in a further modification to the system described above each page 1400 of pattern space, defined in the allocation module 408, comprises a large general area 1402 of pattern space which can be used for a variety of purposes, and a document completion area 1404 which is reserved for use in the send box of one or more documents. The allocation module is arranged, when it receives a request for pattern space by the PoD tool 400 for a document 1410, to find the next page 1400 which is available, allocate the document completion area 1404 to the send box 1412 on the document, and break up the general area 1402 so that it can allocate parts of it to the other pattern areas on the document 1410. In this case the document 1410 includes two further pattern areas 1414, 1416, which the PoD tool 400 identifies to the allocation module 408 by indicating their size, their function, the unique identity of the document 1410 and the application to which the document 1410 relates and the appropriate ASH 306. The allocation module 408 identifies the pattern space page 1400 as having some available pattern space in it and allocates the document completion area 1404 from it to the send box 1412. It also allocates further areas 1418, 1420 of pattern space to the pattern areas 1414, 1416.

Then when the PoD tool 400 requests further pattern space for a further document 1422 having a send box 1424 and another pattern area 1426, the allocation module 408 first checks whether the document is associated with the same application, or at least can be processed by the same ASH as the first document 1400. If it is not, then a different pattern space page is used. However, if it is, the allocation module 408 identifies the page 1400 as still having suitable available space on it. It therefore allocates the same document completion area 1404 to the send box 1424 of this document also, and allocates an available area 1428 from the pattern space page 1400 to the pattern area 1426. All of these allocations are recorded in the server 304, for communication to the ASH 306 when pen stroke interpretation is required.

When the pen 300 is used to mark the send box 1412, 1424 of one of the documents 1410 1422, it sends the pen stroke data to the allocation module 408 which identifies the send box as being related to one of the two documents 1410, 1422, and identifies the correct ASH 306. When the ASH receives the pen stroke data from the pen 300, it checks the pattern space area which has been allocated to the part of the document on which the pen strokes have been made, and from that determines which of the two documents 1410, 1422 have been marked. This enables it to process the pen stroke data correctly.

CLAIMS

1. A system for creating documents having a position identifying pattern thereon, the system comprising a pattern allocation system arranged to receive a request for a plurality of pattern space areas for respective pattern areas of a document, to analyse an area of available pattern space thereby to identify a suitable pattern space area for allocation to each of the pattern areas, and hence to determine the relative positions of the pattern space areas in pattern space.

2. A system according to claim 1 arranged such that the relative positions of the pattern areas on the document can differ from the relative positions of the respective pattern space areas in the pattern space.

3. A system according to claim 1 or claim 2 arranged to create a plurality of similar documents each having the same arrangement of pattern areas on it, and arranged such that the relative positions in pattern space of the pattern space areas allocated to one of the documents can differ from the relative positions in pattern space of the pattern space areas allocated to the others.

4. A system according to any foregoing claim wherein the pattern space is divided into pages and the pattern allocation system is arranged, during creation of a document, to allocate a pattern space area comprising a first part of one of the pages to the document, and to keep a further pattern space area comprising a second part of that page available for allocation to another document.

5. A system according to claim 4 wherein the pattern allocation system is arranged to take all of the pattern space areas for allocation to each document from a respective single page of pattern space.

6. A system according to claim 4 wherein the pattern allocation system is arranged to take at least two of said pattern space areas for allocation to one of the documents from different pages of pattern space.

7. A system according to any foregoing claim wherein in the pattern allocation system is arranged to select one of said pattern space areas for allocation to the document on the basis of the size of the pattern area, and the layout of available parts of the pattern space that have not already been allocated.

8. A system according to any of claims 4 to 6 wherein the pattern allocation system is arranged to select which of a plurality of pages to take each of the pattern space areas from, on the basis of the size of the pattern area, and the parts of said plurality of pages that have already been allocated.

9. A system according to any foregoing claim wherein the pattern space areas for one of the documents are of different sizes.

10. A system according to any foregoing claim wherein the pattern space allocation system is arranged to make a separate record of the allocation of each pattern space area to enable the interpretation of pen strokes made on the document.

11. A system according to claim 10 arranged to create documents from which pen strokes can be interpreted by a plurality of pen stroke interpretation systems, wherein the record for each pattern space area includes an indication of an appropriate pen stroke interpretation system for the document to which the pattern space area has been allocated.

12. A system according to claim 10 or claim 11 wherein the record for each pattern space area includes an indication of the identity of the document to which the pattern space area has been allocated.

13. A system according to claim 4, or any foregoing claim dependent thereon, wherein each page has a pre-defined document completion pattern space area arranged to be used to indicate when a user has finished marking a document.

14. A system according to any foregoing claim wherein the pattern allocation system is arranged to allocate the same document completion pattern space area to more than one document.

15. A pen stroke interpretation system arranged to interpret pen strokes made on a pattern area of a document having a position identifying pattern thereon, the system having defined therein a plurality of pattern space areas taken from a defined pattern space and allocated to a particular document, and, for each of the pattern space areas, an individual association with the particular document and a particular function associated with that document, whereby the pen stroke interpretation system can identify each of the pattern space areas and process pen stroke data associated with it.

16. A method of allocating pattern space to a document, the document having a plurality of pattern areas with a position identifying pattern thereon, the method including defining a pattern space, receiving a request for a plurality of pattern space areas within the pattern space for respective areas of a document, analysing an available area of the pattern space thereby to identify a suitable pattern space area for allocation to each of the

pattern areas, and hence to determine the relative positions of the pattern space areas in pattern space.

17. A method of creating a document including creating an electronic document and allocating pattern space to the document according to the method of claim 16.

18. A method of creating a document according to claim 17 further comprising printing the document.

19. A method according to claim 18 wherein the allocation of pattern space to the document is carried out in response to a request to print the document.

20. A data carrier carrying data arranged to control a computer system to carry out the method of any of claims 16 to 19.

21. A data carrier carrying data arranged to cause a computer system to operate as a system according to any of claims 1 to 15.

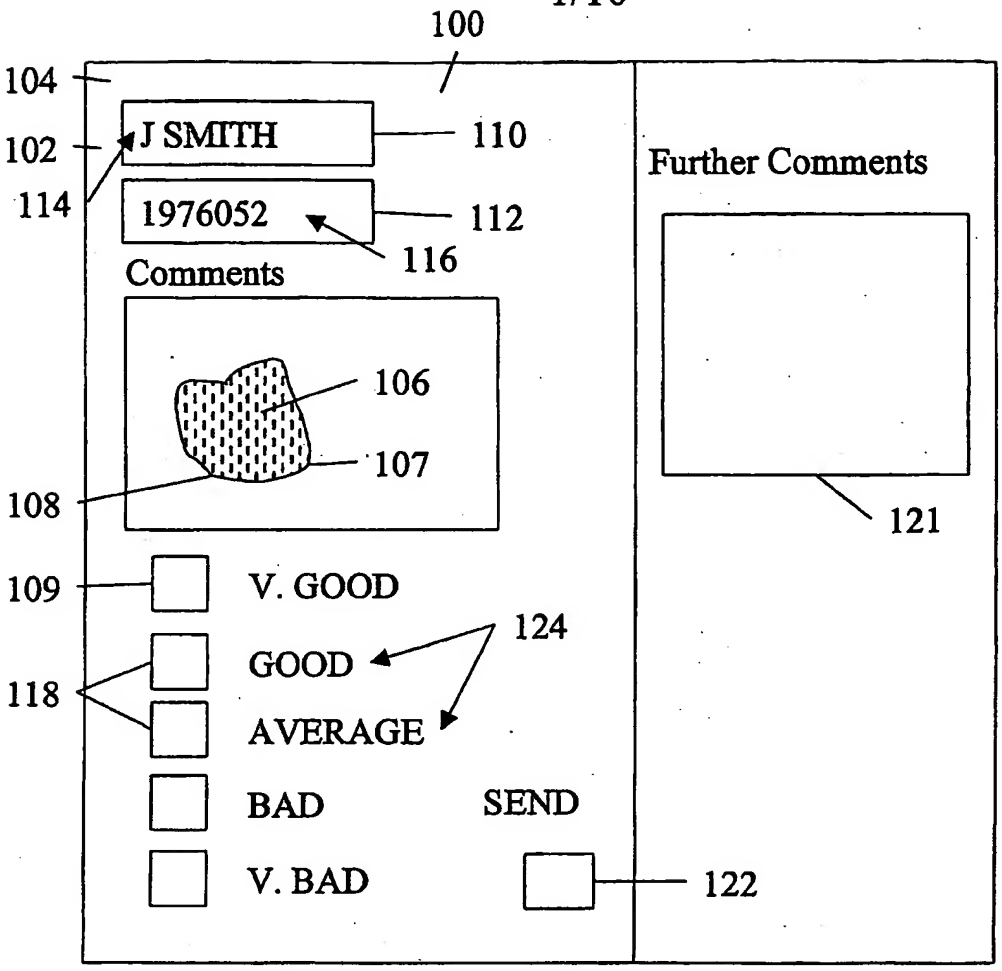

100
104
102
114
J SMITH
110
1976052
112
116
Comments
106
107
108
Further Comments
121
109
V. GOOD
124
GOOD
118
AVERAGE
BAD
SEND
V. BAD
122

Fig 1

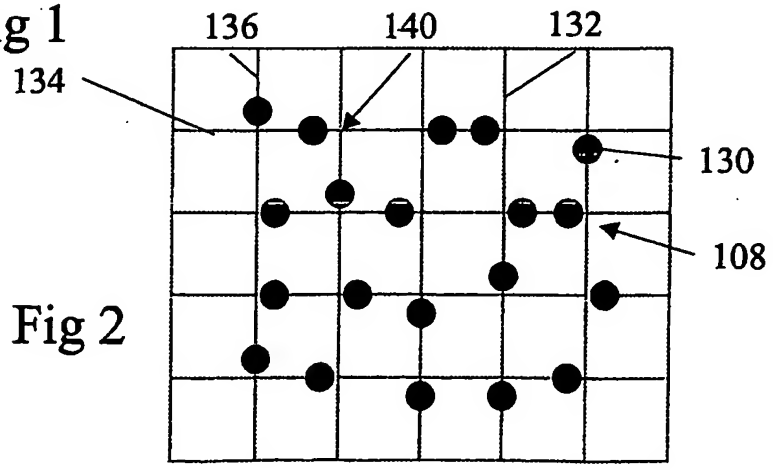

136
140
132
134
130
108

Fig 2

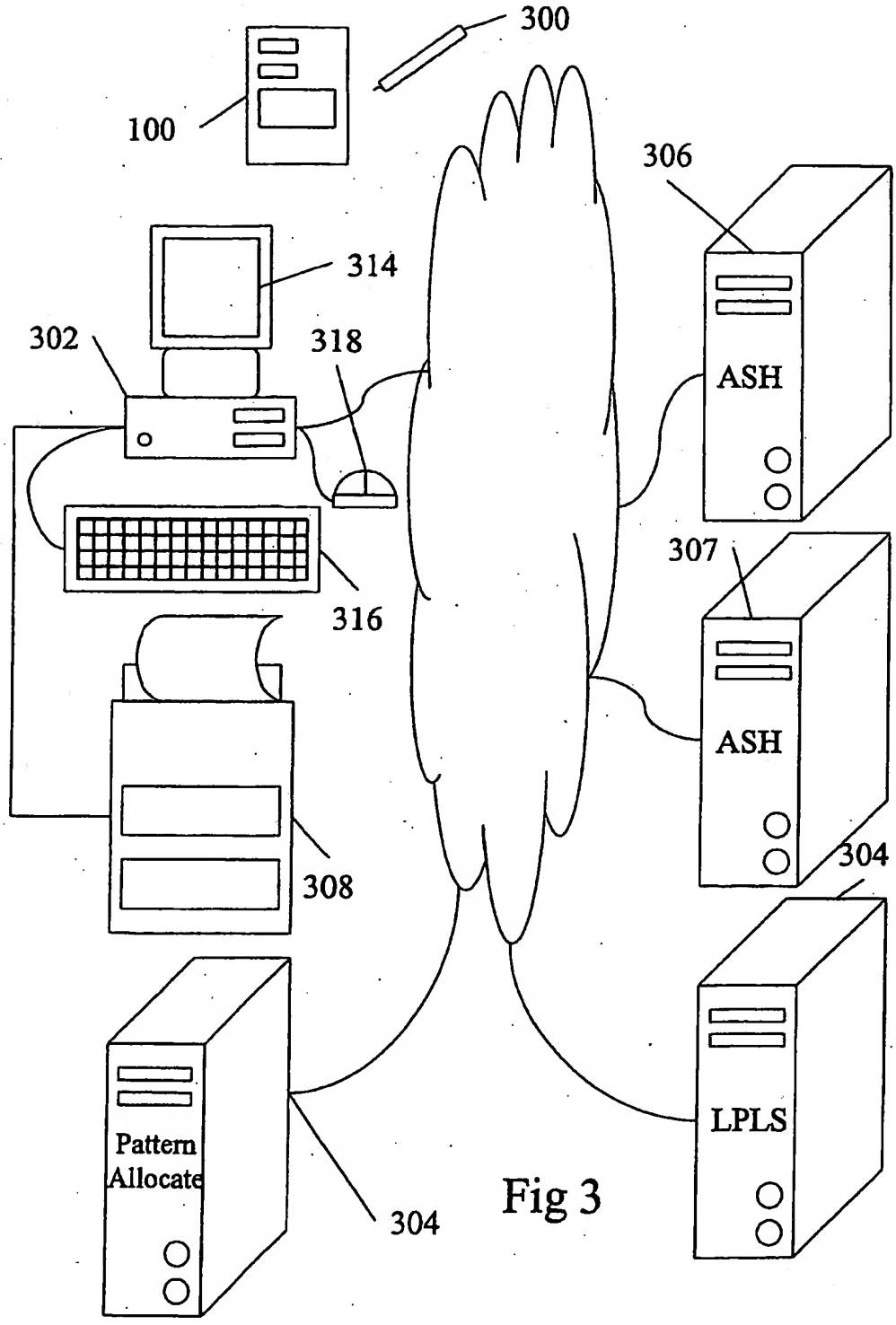

300
100
306
314
302
318
ASH
316
307
ASH
308
304
Pattern
Allocate
304
LPLS

Fig 3

Fig 4 (Prior Art)

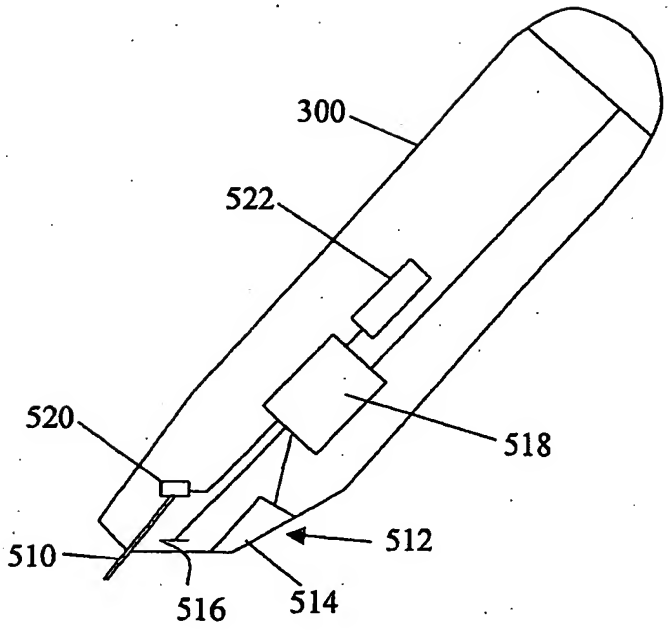


Fig 5

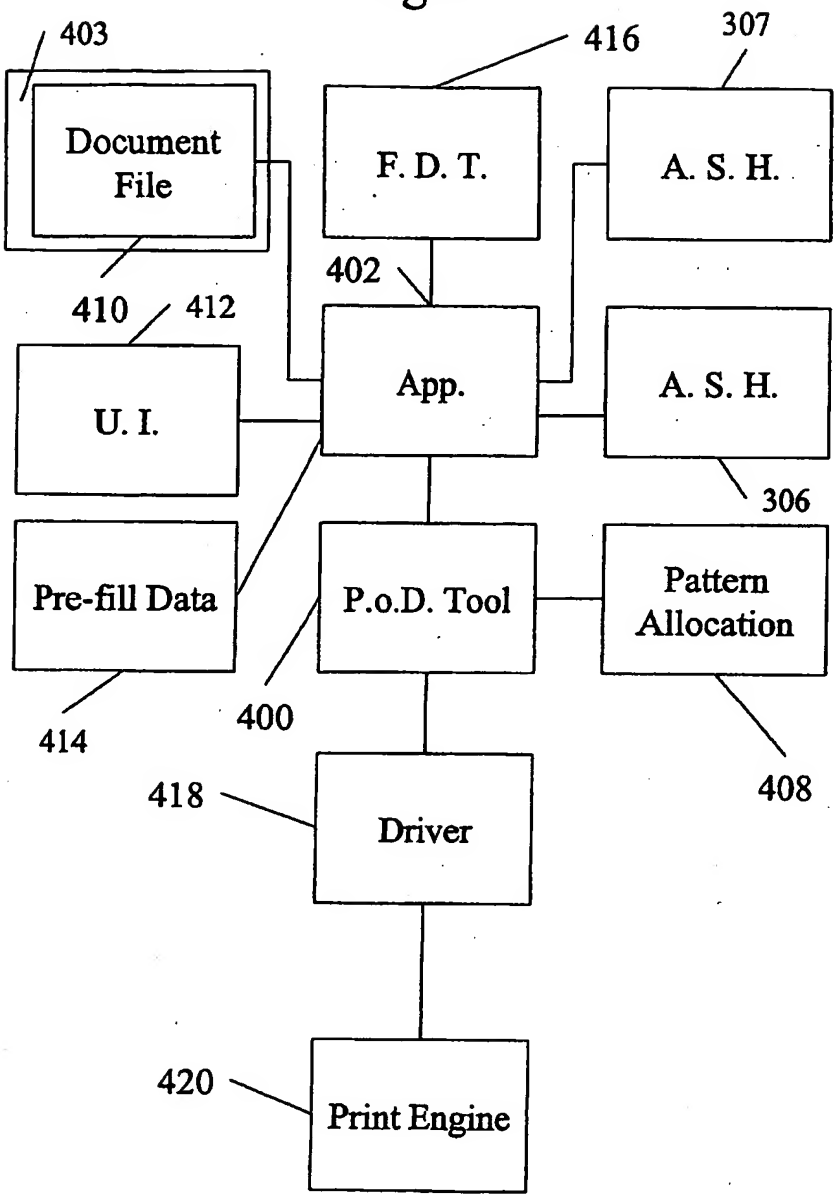
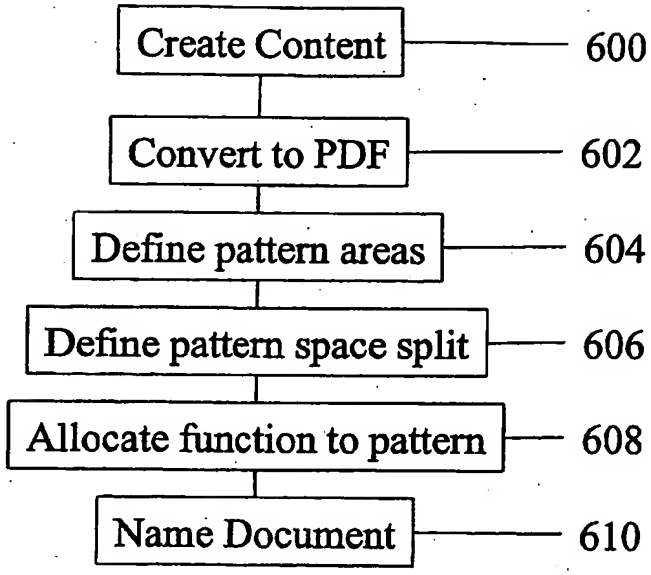

403
Document File
416
F. D. T.
307
A. S. H.
402
410
412
U. I.
App.
A. S. H.
306
Pre-fill Data
P.o.D. Tool
Pattern Allocation
414
400
408
418
Driver
420
Print Engine

Fig 6


Create Content
600
Convert to PDF
602
Define pattern areas
604
Define pattern space split
606
Allocate function to pattern
608
Name Document
610

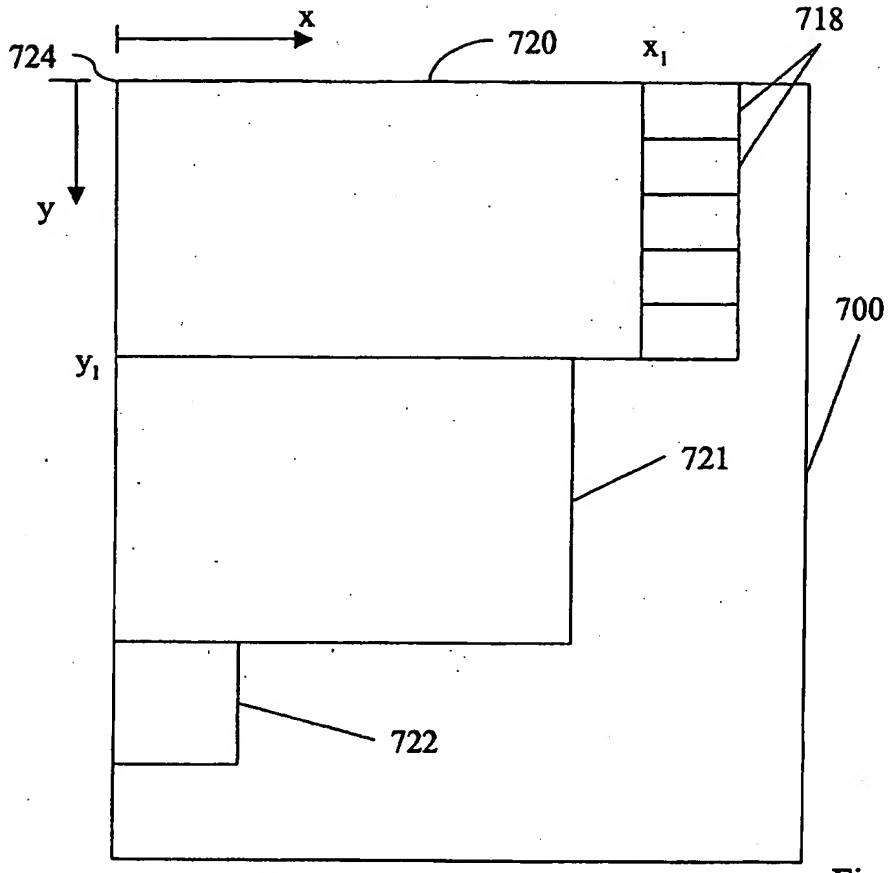

x
724
720
x_1
718
y
700
y_1
721
722

Fig 7

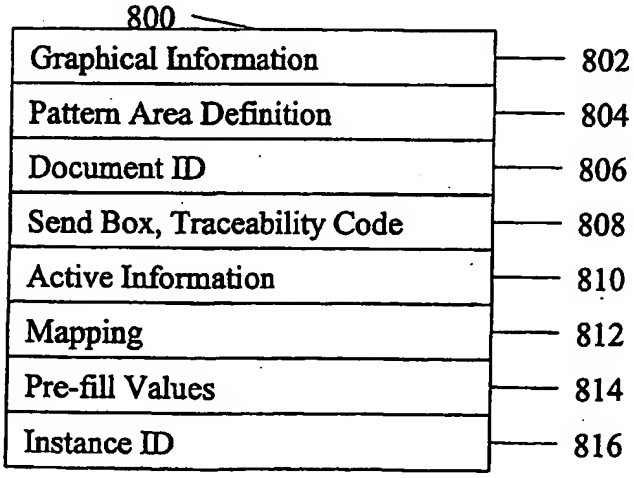
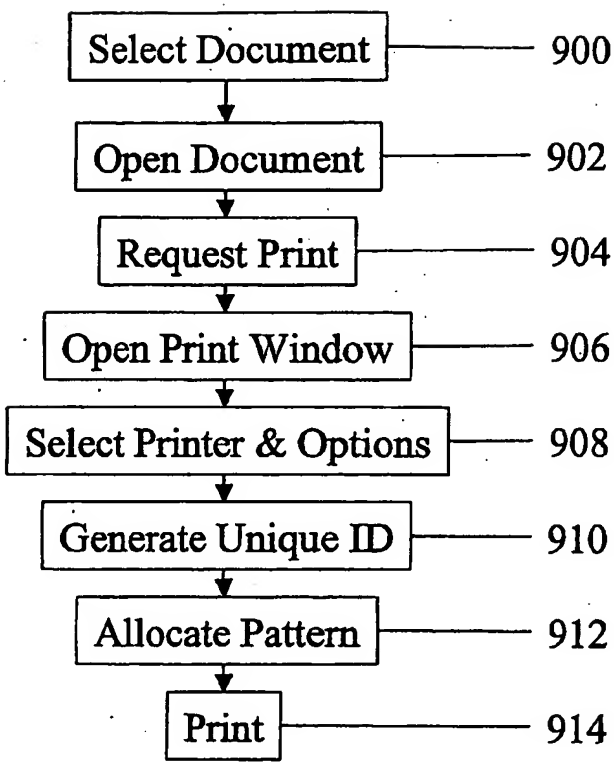

800
Graphical Information
802
Pattern Area Definition
804
Document ID
806
Send Box, Traceability Code
808
Active Information
810
Mapping
812
Pre-fill Values
814
Instance ID
816

Fig 8

Fig 9


Select Document
900
Open Document
902
Request Print
904
Open Print Window
906
Select Printer & Options
908
Generate Unique ID
910
Allocate Pattern
912
Print
914

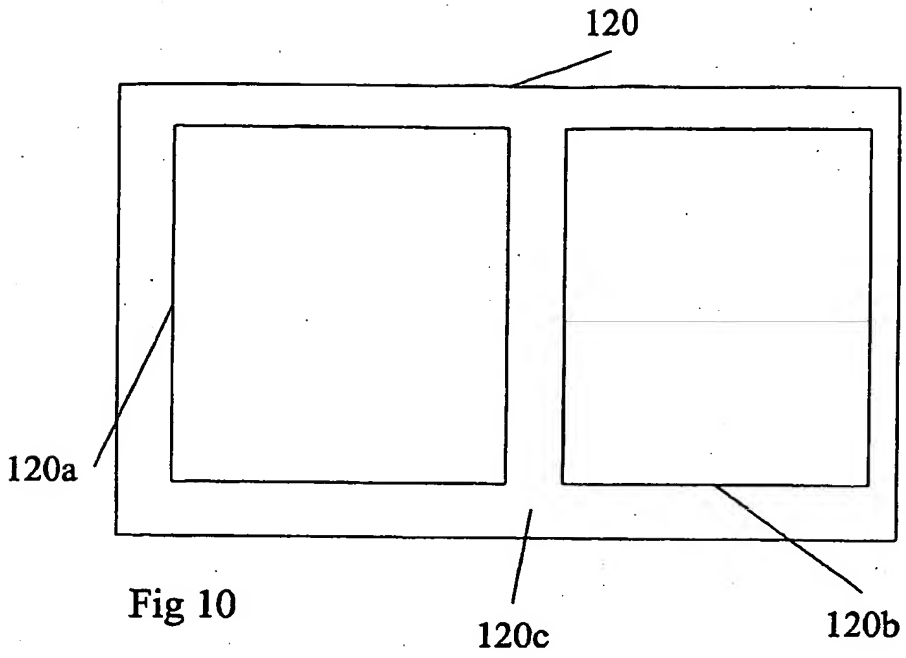

120
120a
120c
120b

Fig 10

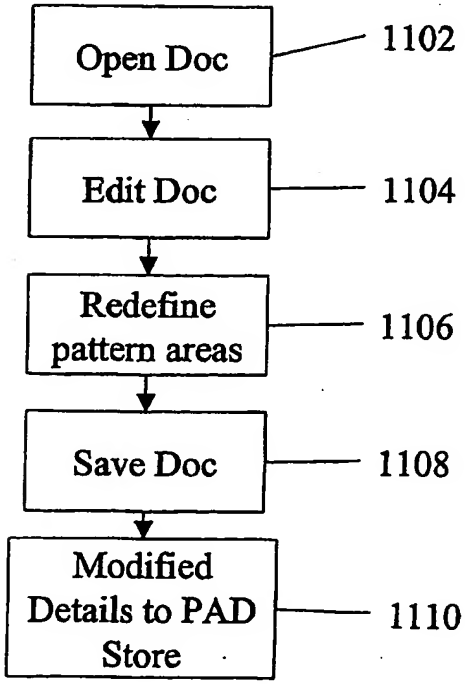

Open Doc
1102
Edit Doc
1104
Redefine pattern areas
1106
Save Doc
1108
Modified Details to PAD Store
1110

Fig 11

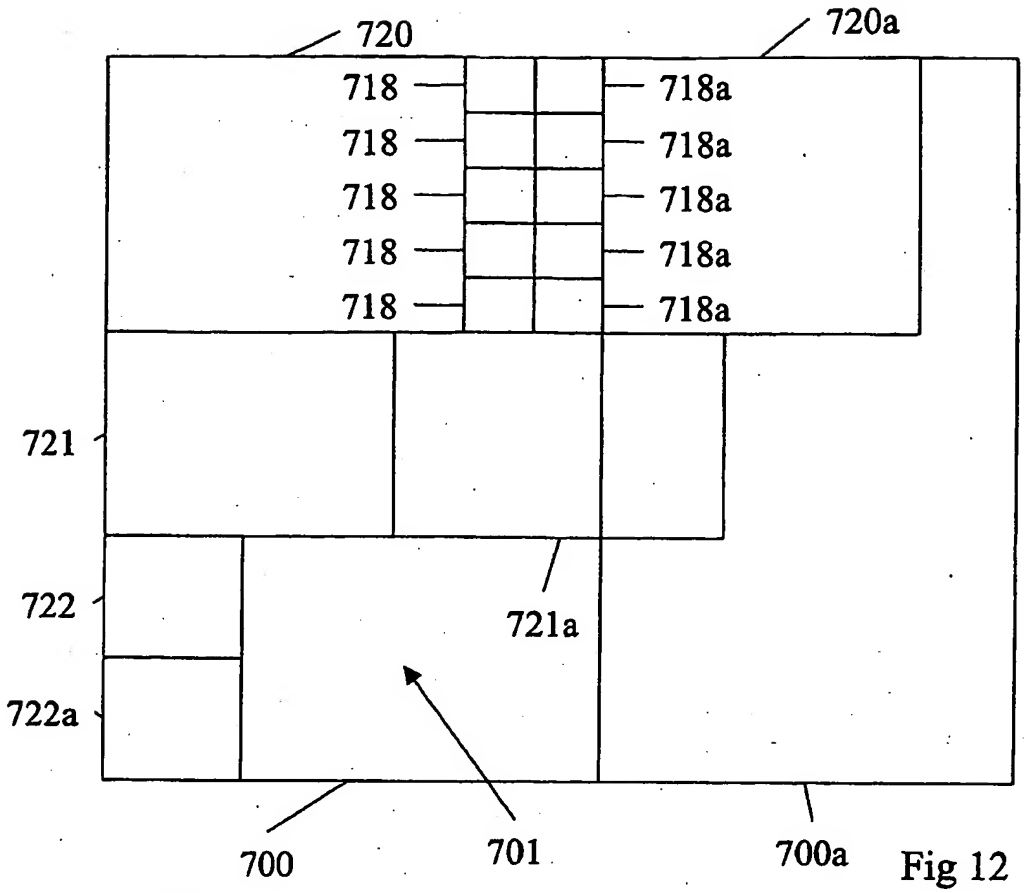

720
720a
718
718a
718
718a
718
718a
718
718a
718
718a
721
722
721a
722a
700
701
700a

Fig 12

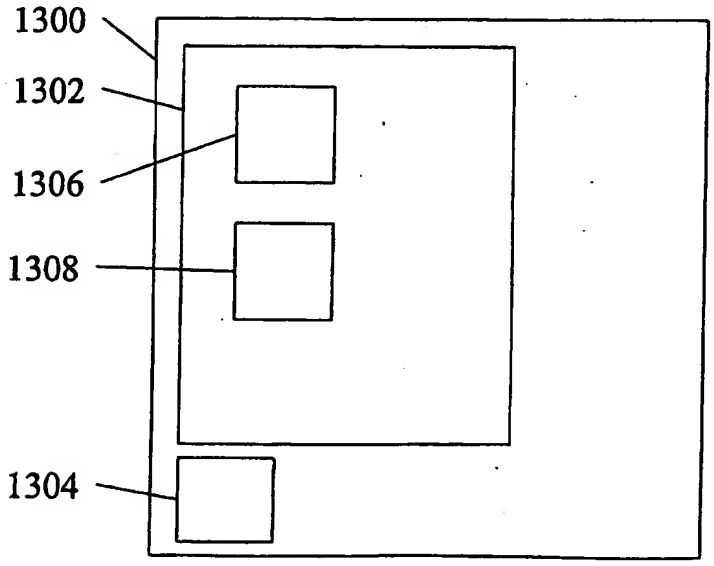

1300
1302
1306
1308
1304

Fig 13

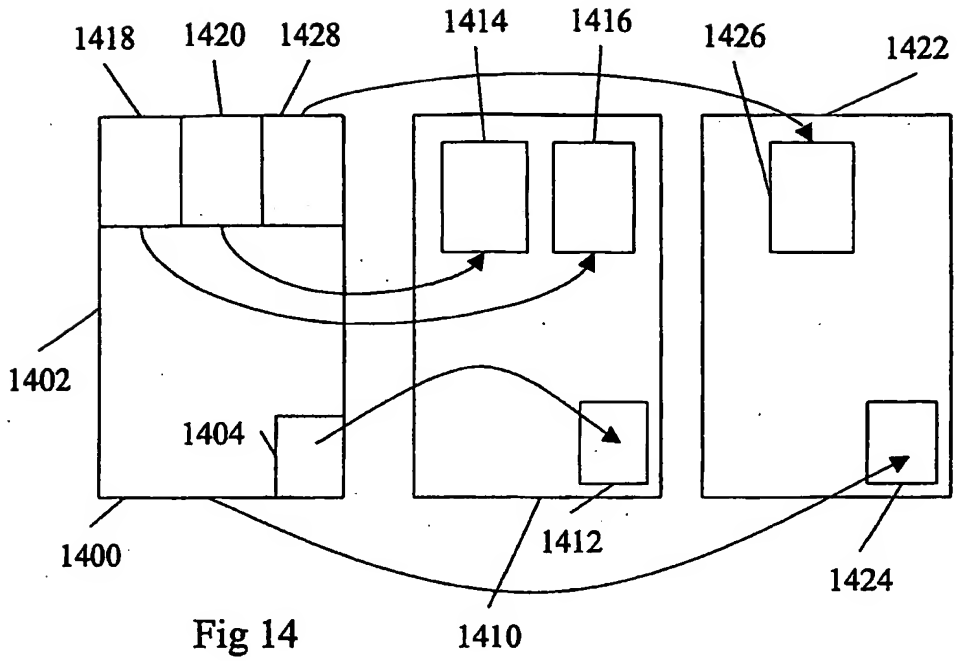

1418
1420
1428
1414
1416
1426
1422
1402
1404
1400
1412
1424
1410

Fig 14